REMARKS

Claims 1, 5, 8, 11, 13, 17, 20, 21, and 23 have been amended. No claims have been cancelled. Claims 1-24 remain in the application. Further examination and reconsideration of the application, as amended, is hereby requested.

Claims 1-24 were rejected under 35 U.S.C. §102(b) as being anticipated by Barbour et al. (Commonly Assigned U.S. Patent No, 6,318,828, hereafter Barbour). Applicant has amended his claims to more particularly and distinctly define and distinguish his invention over the cited reference. As amended, Applicant respectfully traverses these rejections because Barbour does not disclose all of the limitations of the Applicant's claims as arranged in the claimed structure. The standard for prima facie anticipation under 35 USC 102 is that "[t]here must be *no difference* between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention." (Scripps Clinic & Research Found. v. Genentech, Inc., 18 USPQ2d 1001, 1010 (Fed. Cir. 1991)) That is, the prior art reference must disclose each element of the claimed invention "*arranged as in the claim*" in question. (Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984)).

Barbour instead discloses using a variable duty cycle on the voltage applied to a printhead for all primitives (groups of firing resistors) of the printhead and does not disclose, teach or suggest for each primitive, varying the magnitude of the voltage or current to each primitive during a printing cycle for each subset of the printing cycle where the number of resistors fired varies. Barbour only discloses varying the magnitude of the voltage that is applied to *all of the primitives* on a Barbour printhead based on results of a calibration cycle prior to operation of the printhead during a printing firing cycle in normal printing operation. This action is not the same as varying the magnitude of the voltage individually for each of the primitives during printing operation, such as during subsets of the printing firing cycles.

For instance, Applicant in his Background Section of the Disclosure stated, "In the past, multiple drivers have typically been used to apply the firing signals to

different groups of firing resistors. Firing only one resistor at a time by a given driver reduces or prevents energy variation error terms that may occur due to parasitic effects, but at the expense of increased interconnection complexity and performance." Barbour is one such previous printhead that discloses different groups of firing resistors (aka, primitives) (see Figs.15 and 17, and col. 7:61 - col.8:5) and only firing one resistor at a time by a given driver (See col. 8:18-47). In fact, Barbour asserts that "[s]ince it is desirable to print a vertical line with **a moving slanted printhead**, the resistors **must be fired in a sequence** with the leading resistors in each column firing first" (Emphasis added). Barbour further notes, "[a]s the printhead moves back and forth across the print media, the resistor that is leading will subsequently change, and hence the firing sequence changes." In col. 9:35-53, Barbour states, "During operation of the printing system 600, the power supply 618 provides **a controlled voltage or voltages** to the printer controller 610 and processing driver head 622. ... the data processor 624 [is enabled] to dynamically formulate and perform its own firing and timing operations based on sensed and given operating information for regulating the temperature of, and the energy delivered to the printhead assembly 626. These formulated **decisions are based on printhead temperatures sensed by the sensors 623, sensed amount of power supplied, real time tests, and preprogrammed known optimal operating ranges, such as temperature and energy ranges, scan axis directionality errors, etc.**" Nowhere does Barbour disclose that the "magnitude of a voltage or a current of said drive signal" is "in dependence on the variable number of firing resistors to be fired simultaneously *in a given subset during the printing firing cycle*." Instead, Barbour discloses adjusting the voltage level to a plurality of drivers based on the turn-on-energy (TOE) of the printhead assembly (Col. 13:45-47), but this value is actually set during a calibration operation that is used to set the operating voltage level which is then written to the printhead assembly memory device. The operating voltage level is not changed during normal printer operation that involves multiple printing firing cycles. Further, the operating voltage is not varied for each individual resistor group (primitive) during subsets of the printing firing cycles, but rather is applied to all four groups of resistors on the Barbour printhead. To reduce unwanted EMI, Barbour staggers the time of the switching of the nozzles so that the resistors between primitive groups are delayed (see col. 15:36-56 and Fig.

11). This operation of time staggering is not the same as changing the magnitude of the voltage during the printing firing cycles.

In Barbour, to compensate for variations in the primitive supply voltage VPP applied to the printhead that arise due to parasitic interconnect resistance the energy delivered to resistors in Barbour is instead varied by adjusting the fire pulse width to ensure constant energy delivery (see col. 25: 5-12 and 52-64). Accordingly, Barbour does not vary the magnitude of the voltage to the individual primitives in a subset of the printing firing cycle as claimed by the Applicant but rather just the pulse width. While varying the pulse width is useful in many circumstances, if a high VPP is required in a worse case scenario, the pulse width could be truncated to a point that a resistor may be unable to withstand the instantaneous power transmitted (see col. 28:22-31). This effect is because Barbour calibrates **a fixed VPP during printing operation** based on a level adequate to ensure an adequate firing energy level for full drop volume firing in "blackout conditions" when all resistors are fired simultaneously. Thus, the calibration procedure of Barbour sets a upper worse-case scenario VPP voltage effective for all firing conditions, regardless of the number of nozzles fired simultaneously" (see col. 28:54-57). This teaches away from the Applicants claimed language of "adjusting a magnitude of a voltage or a current of said drive signal in dependence on the variable number of firing resistors during a subset of the printing firing cycle." By starting with a higher VPP voltage, when firing a single resistor, the pulse duration can be quite short, perhaps below a point determined during calibration. Barbour states that reliability problems can arise when a too-high power is applied during a short duration to obtain the needed duration in col. 29:48-62. To compensate, in Barbour during calibration, all quadrant primaries are ensured to truncate the firing signal to provide a margin for pulse expansion in unexpectedly low VPP conditions. Fig. 27 shows how the timing of the pulse is adjusted due to VPP levels and not "for setting the VPP levels based on the number of resistors firing" as the Examiner is asserting. As noted in col. 30:12-24, the calibration of VPP voltage is done in factory or when a cartridge is installed in a printer and stored in memory to be the operating voltage V_{oper}. Accordingly, Barbour does not disclose adjusting the VPP voltage as the

number of firing resistors changes to each separate primitive during normal printing operation of the printer.

Specifically for each independent claim, the differences in the structure between the Barbour disclosure and the claimed invention of the Applicant are as follows. Claim 1, as amended, reads as follows:

> 1. A driver circuit for driving simultaneously a variable number of firing resistors for a printhead *during a printing firing cycle*, the driver circuit comprising:
>
> a drive circuit for supplying firing pulses for firing the variable number of firing resistors *during the printing firing cycle*;
>
> a circuit for adjusting a magnitude of a voltage or a current of said drive signal *during the printing firing cycle* in dependence on the variable number of firing resistors to be fired simultaneously *in a given subset during the printing firing cycle*.

Support for these limitations is found throughout the specification but also in particular in paragraphs [0015-0018].

As noted above, Barbour does not disclose "a circuit for adjusting a magnitude of voltage or a current of said drive signal during the printing firing cycle in dependence on the variable number of firing resistors to be fired simultaneously in a given subset during the printing firing cycle," as Applicant is claiming. Instead, Barbour teaches varying the voltage pulse width (the duty cycle) during the printing firing cycle and only determining the magnitude of the voltage during a calibration operation and setting the operating voltage to that magnitude as a fixed and not an adjustable voltage that is dependent on the variable number of firing resistors to be fired simultaneously in a given subset during the printing firing cycle. By being able to adjust the magnitude of the voltage applied while the number of resistors fired varies, allows for a more consistent and reliable printhead and thus is inventive over Barbour.

Independent claims 8, 11, 13, 20, and 23 have been amended similarly to claim 1 as follows below.

> 8. In a printhead control apparatus comprising a driver circuit for providing energy pulses to a set of firing resistor loads connected in parallel, each load having a switch for connecting the load to the driver circuit so that a variable number of the loads can be simultaneously connected to the driver circuit to receive energy pulses during a *printing firing cycle*, a method for maintaining nominally constant energy in an individual load, the method comprising:

determining the variable number of the loads to be simultaneously connected to an energy source for the *printing firing cycle during a given subset of the printing firing cycle*;

adjusting a voltage magnitude or current magnitude of the energy pulse in dependence on the variable number *during the given subset of the printing firing cycle*, so that the voltage magnitude or current magnitude increases as the variable number increases to maintain a nominally constant energy applied to the load independent of the variable number.

11. A method for driving an inkjet printhead having a set of firing resistors, each responsive to a firing pulse for ejecting ink from a corresponding nozzle, the firing resistors connected in parallel, there being a parasitic resistance effectively in series connection with said set of firing resistors, each resistor having an associated switch for connecting the resistor to a driver circuit so that a variable number of the resistors can be simultaneously connected to the driver circuit to receive energy pulses during a *printing firing cycle*, the method comprising:

determining the variable number of the loads to be simultaneously connected to the energy source for the *printing firing cycle*;

adjusting a voltage magnitude of the energy pulse in dependence on the variable number *during a given subset of the printing firing cycle*, so that the voltage magnitude increases as the variable number increases *during the given subset of the printing firing cycle* to maintain a nominally constant voltage applied to the load independent of the variable number.

13. A driver circuit for driving simultaneously a variable number of firing resistors for a printhead, the driver circuit comprising:

a drive circuit for supplying a drive signal for firing the variable number of firing resistors *during a printing firing cycle*;

means for adjusting a magnitude of a voltage or a current of said drive signal *during the printing firing cycle* in dependence on the variable number of firing resistors to be fired simultaneously *in a given subset during the printing firing cycle*.

20. A driver circuit for firing simultaneously a variable number of firing resistors for associated nozzles in a printhead, the driver circuit comprising:

an energy source for providing electrical power to fire said firing resistors;

a nozzle counter for determining a nozzle count of the variable number of nozzles whose resistors are to be fired in *a given printing firing cycle*;

a programmable offset generator for generating an output control voltage or current dependent on said nozzle count *during a given subset of the given printing firing cycle*;

a drive circuit having an output connected to a circuit output terminal for connection to the printhead, said drive circuit for selectively applying variable voltage or current from said energy source to the circuit output in dependence on said output control voltage or current *during the given subset of the given printing firing cycle*.

23. A driver circuit for driving simultaneously a variable number of firing resistors for associated nozzles in a printhead, the driver circuit comprising:

a voltage source for providing electrical power to fire said firing resistors;

a nozzle counter for determining a nozzle count of the variable number of nozzles whose resistors are to be fired in *a given subset of a printing* firing cycle;

a programmable offset generator for generating an output control voltage dependent on said nozzle count *during the subset of the printing firing cycle*;

a high side drive circuit having an output connected to a circuit output terminal for connection to the printhead, said high side drive circuit for selectively applying a firing pulse having a programmable magnitude to the circuit output in dependence on said output control voltage *during the printing firing cycle*.

The dependent claims are believed patentable based at least on the patentability of the respective parent claim. However, the dependent claims are also believe separately patentable, a few of which will be discussed.

Claim 5 includes the limitation of "wherein said drive circuit supplies a voltage of a predetermined magnitude, and said circuit applies *a data variable offset voltage* **dependent** on said variable number of firing resistors and *a fixed offset voltage* **not dependent** on said variable number of firing resistors. Barbour does not disclose applying an offset voltage but rather discloses programming a DAC which supplies an output voltage as fixed operating voltage to all primitives (see col. 30:12-23). By applying a data variable offset voltage, this data variable offset voltage can be directly related to the DSUM value thus simplifying control circuit and allowing a fixed offset voltage be set for other factors that are not dependent of the number of firing resistors. (See Fig. 6 and [0024]). Dependent claims 17 and 21 are similarly amended as done with claim 5.

Applicant believes his claims as amended are patentable over the art of record, and that the amendments made herein are within the scope of a search properly conducted under the provisions of MPEP 904.02. Accordingly, claims 1-24 are deemed to be in condition for allowance, and such allowance is respectfully requested.

If for any reason the Examiner finds the Application other than in a condition for allowance, the Examiner is respectfully requested to call Applicant's undersigned representative at the number listed below to discuss the steps necessary for placing the application in condition for allowance.

The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 08-2025. Should such fees be associated with an extension of time, Applicants respectfully request that this paper be considered a petition therefore.

Hewlett-Packard Company
Legal Department
1000 NE Circle Blvd.
Corvallis, OR 97330
Telephone: (541)715-4197
Fax: (541)715-8581

Respectfully Submitted,
William S. Eaton
By: Timothy F Myers
Timothy F. Myers
Patent Attorney
Registration No. 42,919